DECS+
Version 4.0

DLG ERROR CHECKING SYSTEM PLUS DATABASE LOOK-UP

Users Guide

U.S. Department of the Interior
U.S. Geological Survey
National Mapping Division

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1 Description

The DLG Error Checking System (DECS+) was designed to perform a final check of Digital Line Graph (DLG) products before archival into the National Digital Cartographic Database (NDCDB). DECS+ version 4.0 reflects a number of changes that have been designed to more fully meet the needs of DLG production centers throughout the National Mapping Division (NMD).

2 Background

Various tools are used to validate the integrity of the digital product throughout the DLG production process. During the collection and validation processes, Digital Cartographic Files (DCFs) are validated for topologic and attribute relationships using NMD's PROSIX & RevPG software. In addition, data collectors manually verify that digital header data corresponds to meta data from the source graphic.

The DLG header records were manually verified one last time before shipment to the NDCDB. This check primarily involved manual comparison of names and dates in the DLG header against the published map and GNIS printouts.

Prior to final archival in the NDCDB, the DLG was once again checked to insure the integrity of the product. In the past, problems were identified at this final check which resulted in a rejection of the DLG back to the production center for correction. This rejection process sometimes involved other adjoining quads and resulted in long turn-around times.

Initially, the DECS system was created to provide a suite of checks (based on previous rejections) which would limit the number of DLG rejections before shipment to the NDCDB office. This effort was successful in reducing the time and cost associated with the rejection process.

More recently, the DECS+ software was redesigned to provide a more thorough check of the entire DLG. Header checks were expanded to include nearly all the DLG header fields. Logical and format checks were written to validate the data portion of the DLG. **DLG attribute and spatial relationship checks were not included since the PROSIX software already performed these checks.**

DECS+ 4.0 represents a significant milestone in the software's development. This version is intended to complete the baseline of checks required before final DLG archival in the NDCDB.

The same checks used by the archival process are now available to DLG producers, eliminating nearly all of the time and cost associated with DLG rejections.

Modular libraries were implemented in version 3.0 to allow the Operational Data Base (ODB), which will perform the final archival, to share the same validation code as DECS+. This assures consistency between the two applications and greatly simplifies future maintenance activities.

3 Feature Overview

DECS+ is a straightforward program that reads Standard and Optional format DLGs, outputs the DLG header data for visual inspection, performs numerous automated checks, and outputs messages to the user indicating errors and potential errors found by the automated checks.

These automated checks can be divided into the following categories:

Format Checks
Header Checks
Data Base Checks

Format checks identify general problems dealing with the DLG file structure. These checks are performed primarily by the DLG loaders used by the DECS+ software and are supplemented by a number of preliminary format checks.

Header checks verify only data contained within the first few lines of the DLG commonly referred to as the header data. This header block contains information, such as quadname, state(s), source date, revision date, scale, and contour intervals. Data to populate these fields are primarily derived from the source graphic used to produce the DLG, but certain domains, limits and logical relationships exist for these fields which can be validated for accuracy.

Data Base checks compare specific fields within the DLG header with information stored in Oracle data base tables to validate the consistency of the DLG with other established NMD meta data sources.

Please consult the Release Notes for DECS+ version 4.0 for a complete list of features included since the last release.

4 Hardware Requirements

The program requires no special terminal characteristics (for example, xterm) and should display on any text-based monitor.

The database look-up functions require Internet access to remote data bases containing meta data information. This option can be turned off from the command line at run-time to by-pass this requirement but significant error checking functions will also be omitted.

5 Software Requirements

DECS was written in the C language and compiled with the Oracle Pro*C pre-compiler and the GNU GCC C compiler into a single executable file to run in the Data General UNIX (DG/UX ver. 5.4R2.01 to 5.4R3.10) and the Sun (SunOS 5.6) operating environment.

6 DECS+ Setup

6.1 Basic Setup

The DECS+ executable should be installed in a directory pointed to by the PATH environment variable. The DECS executable is usually distributed with a version number (decs4.0) to avoid confusion with previous releases. The executable can be renamed without affecting the program. This is all that is necessary to execute the basic DECS+ program but additional setup is required to assure the Oracle database lookup functions properly.

6.2 Oracle Setup

Most of the NMD servers already have the necessary Oracle configuration files installed. In these cases, the only change needed to run DECS 4.0 is the addition of an environment variable DECS_TNSNAME. This variable identifies the SQL*NET V2 service name associated with the NMD Map Catalog (MAPCAT) database. In most cases this service name is ‘prod’.

It is recommended that the System Administrator define this variable in a system profile so that all users obtain this definition when logging on. This also insures that any future changes can be done for all users. This can be done by adding the following line to the /etc/login file:

```
setenv DECS_TNSNAME prod
```

Users may also define or override this variable in their own .login file located in their home directory.

If, after following the instructions above, DECS+ fails the database lookup, have your System Administrator call the DECS OPR referenced at the end of this document for further assistance.

7 Executing DECS+

7.1 Input:

The only required input to DECS+ is a valid DLG filename. DECS+ accepts Standard and Optional DLG file formats as input. File type is automatically recognized by the software based on the existence and position of a newline character in the first input line. This detection feature can be overridden by specifying [+s] for Standard format or [+o] for Optional format on the command-line at the startup of the software.

More than one file can be specified on the command line by entering individual filenames or by including valid UNIX wildcard combinations as a filename. Some examples are shown below:

```
decs+ file1 file2 file3
decs+ abcpl??.dd
decs+ *.dd
```

If a filename is not specified the following message will appear:

```
Usage: decs+ [flags] infile1 [infile2...]
         Flags:
                  -db     - Turn off database checks.
                  -mapcat - Turn off MAPCAT-only database checks.
                  -prelim - Turn off all preliminary checks.
                  -h      - Turn off header display output.
                  +s      - Force use of Standard DLG loader.
                  +o      - Force use of Optional DLG loader.
                  +S      - Summarize multi-run execution.
```

This message gives a summary of all the command line options that exist which modify the run-time results of DECS+. These option flags may be included in any order on the command line but must precede the filename list.

All data base lookup checks are active by default but can be deactivated by including the '-db' flag on the command line. This option prevents any need for Internet connections and prevents all database checks from executing. The MAPCAT checks can be turned off with the '-mapcat' flag. Both examples are shown below:

```
decs+ -db filename
decs+ -mapcat filename
```

This may be necessary if Internet services are not available or limited checking is desired. PLEASE NOTE: Use of these options are strongly discouraged due to the effectiveness these checks provide when included.

The '+S' option displays the following summary at the end of the output.

```
SUMMARY STATS
-------------
Files processed: ##
Passed: ##       Failed: ##
            FILENAMES OF FAILURES:
      ...
      ...
```

The program requires no other user input.

7.2 Output:

All DECS output is directed to the screen unless specifically redirected. To redirect output to another file, use the UNIX redirection operator (>) followed by a filename as shown below:

```
decs DLG1.dd > output.txt
```

NOTE: Redirection of output to a file will result in no output displayed to the screen during program execution.

7.3 Screen Display:

```
---------------------------------
 DLG Error Checking System V4.0
---------------------------------
CONNECTING TO DATABASE AS MAPCAT_GUEST... SUCCEEDED/FAILED
        {Oracle connection errors}

PROCESSING OPTIONAL/STANDARD FILE: im1hpf01.dd
PERFORMING PRELIMINARY CHECKS...
        {Preliminary aborts and errors}
LOADING DLG...
        {loader aborts}


HEADER INFORMATION:
                         DLG                                        DATABASE
                         ---                                        --------
            TYPE: DLG-S
           LEVEL: 3
         SECTION: F01
        FILENAME: im1hpf01.dd
        CARTUNIT: RHINELANDER, WI
    DB QUAD NAME: RHINELANDER
   PRIMARY STATE: WI                            [WI]
          STATE2:                               [ ]
          STATE3:                               [ ]
          STATE4:                               [ ]
            DATE: 1989,                         [1989]
   REVISION DATE: 1995                          [ ]
   REVISION TYPE: D  (digital revision)
           SCALE: 100000
   LARGE CONTOUR: [    ] (  0 feet)             [ ]
     LARGE BATHY: [    ]
   SMALL CONTOUR: [ 102] (10 meters)            [5M]
     SMALL BATHY:
      RESOLUTION:  2.540000000
     SE LATITUDE:    45   45’   0"
    SE LONGITUDE:   -89   45’   0"
         OVERLAY:  HYPSOGRAPHY
HORIZONTAL DATUM: 0                             [0] NAS
  VERTICAL DATUM: 0                             [ ] S9
           NORTH:     3-6
       WEST/EAST: 0-_     3-6
           SOUTH:     0-_

MESSAGES:
                  {Validation Errors and Warnings}
END PROCESSING: im1hpf01.dd
```

7.4 Output Messages:

Output messages fall into three categories: ABORT, ERROR, and WARNING.

An ABORT message indicates that a failure occurred which prevented the software from continuing the validation process. The problem identified by the ABORT message must be corrected before further validation can take place.

An ERROR message indicates that a validation check failed that is considered critical. These messages should ALWAYS be investigated by the user since they indicate a very high probability that the data is in some way incorrect. ERROR messages indicate problems which will not be allowed during the final archival process and will result in rejection of the DLG back to the submitting party.

Data base ERROR messages can indicate a problem with the database itself which must be corrected before final archival. See the database points-of-contact listed at the end of this document for correction of these problems.

A WARNING message indicates a validation check failure occurred on a data element that could not be absolutely checked by the software. In most cases, a problem exists when these messages occur, but not in every case. Therefore, these checks should be investigated but will not prevent final archival in the NDCDB.

Only the ABORT messages stop processing before completion of the checks. ERROR and WARNING messages allow processing to continue until the validation is complete.

A few example output messages are shown below:

```
MESSAGES:
ERROR: Cartunit contains illegal characters.
ERROR: Overlay name is invalid.
WARNING: Line 3 - Filler (1 - 41) is not blank.
WARNING: DLG primary interval does not match the database.
END PROCESSING: im1hpf01.dd
```

8 Format Checks

8.1 General

Format checks are handled by the Standard and Optional DLG loaders and by a number of preliminary checks executed before the DLG is loaded into memory.

The DLG loaders used by DECS expect data to follow the general format defined in Appendix 2-A and 2-B of the Standards for Digital Line Graphs Part 2. In most cases, processing will ABORT if a DLG file does not meet these standards.

The DLG Standard loader more strictly follows the format standards then the Optional loader. The Optional loader was originally designed for more robust applications that allowed some variations to the standards.

Because of this, preliminary checks were written to identify errors that might not otherwise be caught by the loaders themselves. If any of these checks fail, an ABORT message is output and processing of the current file is stopped.

8.2 Preliminary ABORT Messages

ABORT: OUT OF MEMORY
ABORT: You specified an illegal option.
ABORT: Error opening file 'filename'.
ABORT: Error opening file 'filename' to determine format.
ABORT: Error opening file 'filename' for preliminary checks.
ABORT: Unable to determine format of file 'filename'.

ABORT: Overlay is invalid or header is corrupt.
ABORT: Not enough header records before the first node record.
ABORT: The first node record was not found.
ABORT: Last line record ## was not found.
ABORT: Last line record is missing an xy coordinate pair.
ABORT: Last line record is missing an attribute pair.
ABORT: Last line record is missing a text string.
ABORT: Extra data records were found at the end of the file.

ABORT: Node record ## and ## are out of order.
ABORT: Area record ## and ## are out of order.
ABORT: Line record ## and ## are out of order.

ABORT: Incorrect number of node records. ## found, ## expected.

ABORT: Incorrect number of area records. ## found, ## expected.
ABORT: Incorrect number of line records. ## found, ## expected.

ABORT: Missing an xy coordinate pair for node record ##.
ABORT: Missing an xy coordinate pair for area record ##.
ABORT: Missing an xy coordinate pair for line record ##.

ABORT: Missing an attribute pair for node record ##.
ABORT: Missing an attribute pair for area record ##.
ABORT: Missing an attribute pair for line record ##.

ABORT: Missing a text field for node records, ## found, ## expected.
ABORT: Missing a text field for area records, ## found, ## expected.
ABORT: Missing a text field for line records, ## found, ## expected.

8.3 Standard Loader Messages

ABORT: DLG-S loader error.
Error upon reading a character from the file.
ABORT: Error opening file: 'filename'
END OF DLG FILE WAS REACHED TOO SOON
THE DLG STRUCTURE WAS NOT LOADED PROPERLY
RAN OUT OF MEMORY UPON ALLOCATION OF COORDINATES FOR LINES
RAN OUT OF MEMORY UPON ALLOCATION OF ATTRIBUTES FOR LINE
RAN OUT OF MEMORY UPON ALLOCATION OF ATTRIBUTES.

8.4 Optional Loader Messages

The file pointer passed to the loader was NULL.
Out of memory allocating DLGO.
Out of memory allocating node records.
Out of memory allocating area records.
Out of memory allocating line records.

Invalid DLGO node line list.
Invalid DLGO node attrs.

Invalid DLGO area line list
Invalid DLGO area attrs.

ABORT: Missing Comma at column 46
ABORT: Missing Comma at column 56
ABORT: Loader does not support more than 4 control points.
ABORT: Loader does not support data sets with more than one category
WARNING: Line ## - Filler (## - ##) is not blank.
WARNING: Line ## - Filler (## - ##) is not zero or blank.
WARNING: Line ## - Element (## - ##) is not a number.
WARNING: Line ## - Element (## - ##) is not blank or a number.

WARNING: Line ## - Element (## - ##) is not a floating point number.

ABORT: Node ID does not match the expected ID.
ABORT: Area ID does not match the expected ID.
ABORT: Line ID does not match the expected ID.

9 Header Checks

9.1 Cartunit -

ERROR: Cartunit contains zeroes instead of Os.
ERROR: Cartunit missing space after comma.
ERROR: Cartunit missing a comma, and may produce other errors.
ERROR: Cartunit contains illegal characters.
ERROR: Cartunit contains erroneous data, possible missing dash.
ERROR: Cartunit should be all uppercase.
ERROR: Cartunit state abbreviation is invalid.
ERROR: Cartunit state should not be followed by a period.
ERROR: State code is missing after '-' in cartunit.
ERROR: CN/MX are no longer allowed in cartunit state list.
WARNING: Cartunit contains a period.

9.2 Source/Revision Dates and Revision Type.

ERROR: Source date starts in the wrong column or is wrong value.
ERROR: Source date is not followed by a comma.
ERROR: Source date is greater than revision year.
ERROR: Source date is greater than the current year.
ERROR: Source date precedes 1900.
ERROR: Revision date qualifier is not P, I, L, or D.
ERROR: Revision date is greater than the current year.
ERROR: Revision date precedes 1930.
ERROR: Revision date does not exist, revision type should be blank.

9.3 Scale -

ERROR: Scale is not legal.

9.4 Sectional Indicators -

ERROR: Section should be blank when scale is not 100K.
ERROR: Section should NOT be blank when scale is 100K.
ERROR: Section should be F01-08 or S01-32.

9.5 Contour Intervals -

ERROR: Contour interval should not exist.
ERROR: Small contour interval should exist.
ERROR: Small contour interval should end with a 1 or a 2.
ERROR: Small contour interval should be 50 feet. (2M only)
ERROR: Large contour interval should end with a 1 or a 2.
ERROR: Large contour interval is not greater than small contour interval.
ERROR: Large contour interval should not equal the small contour interval.

9.6 Bathymetric Intervals -

ERROR: Bathymetric interval should not exist.
ERROR: Small bathymetric interval is wrong value (or in wrong column.)
ERROR: Large bathymetric interval is wrong value (or in wrong column.)
ERROR: Large bathymetric interval is less than small bathymetric interval.

9.7 Edge Flags -

ERROR: QC flags do not exist.
ERROR: Edge WS is not a legal value.
ERROR: Edge WR is not a legal value.
ERROR: Edge NS is not a legal value.
ERROR: Edge NR is not a legal value.
ERROR: Edge ES is not a legal value.
ERROR: Edge ER is not a legal value.
ERROR: Edge SS is not a legal value.
ERROR: Edge SR is not a legal value.
ERROR: West Status/Reason flag relationship is incorrect.
ERROR: North Status/Reason flag relationship is incorrect.
ERROR: East Status/Reason flag relationship is incorrect.
ERROR: South Status/Reason flag relationship is incorrect.

9.8 DLG Level -

ERROR: DLG Level Code indicates file is not a level 3 DLG.

9.9 Ground Planimetric Reference System -

ERROR: Projection code does not correspond to the scale.
ERROR: First projection parameter out of range compared to UTM.
ERROR: Zone in ground planimetric reference system is not legal.

ERROR: Units of measure should be 2 (meters).

9.10 Resolution -

ERROR: Resolution does not correspond to the scale.

9.11 Latitude/Longitude -

ERROR: SE longitude is not negative.
ERROR: First projection parameter does not match the center of the DLG.
ERROR: Corners are not within the accuracy limit.

9.12 Control Point Labels -

ERROR: Southwest control point label should be SW.
ERROR: Northwest control point label should be NW.
ERROR: Southeast control point label should be SE.
ERROR: Northeast control point label should be NE.

9.13 Overlay Name -

ERROR: Overlay name is invalid.
WARNING: Overlay 2-letter code not found in filename.

9.14 Horizontal/Vertical Datum Fields -

ERROR: Horizontal datum should be blank, 0, 1, 2, 3, or 4.
ERROR: Vertical datum should be blank, 0, 1, or 2.

9.15 Miscellaneous -

ERROR: Number of accuracy/miscellaneous records should be 0.
ERROR: Max number of nodes exceeds 25960.
ERROR: Max number of areas exceeds 25960.
ERROR: Max number of lines exceeds 25938.
ERROR: Number of nodes specified in header is greater than 25960.
ERROR: Number of areas specified in header is greater than 25960
ERROR: Number of lines specified in header is greater than 25938..
ERROR: Number of nodes specified in header is less than 4.
ERROR: Number of areas specified in header is less than 2.
ERROR: Number of lines specified in header is less than 4.
ERROR: Node to area flag does not equal 0 or 1.
ERROR: Node to line flag does not equal 0 or 1.
ERROR: The number of sides should be 4.

10 Data Base Checks

10.1 General

The data base look-up function of DECS+ requires external Oracle data bases which can be accessed via the Internet. These data bases reside at the Mapping Applications Center (MAC) of the USGS located in Reston, VA.

These checks can be turned off by specifying [-db] on the command-line. If this option is used the following WARNING message will appear in the output to remind the user the data base checks were not used:

> WARNING: No fields were verified against the database.

Currently, two data bases, the Geographic Cell Names Data BASE (GCNDB) and the Map Catalog Data Base (MAPCAT) are accessed to perform the data base comparison checks.

GCNDB provides cell name and state information based on the SE lat/long and the file extent. The DLG quadname and the primary state should always match the data base.

Secondary states should also match unless DECS+ reports a message indicating the ordering information was not available from the data base.

The MAPCAT data base provides comparative checking for meta-data fields which include: source date, revision type, revision date, scale, contour intervals, and datums. These comparisons are less accurate and mis-matches are only called WARNINGS in the output messages.

Neither of these tables should be considered 100% authoritative and manual verification may be required when comparison checks between the DLG and the data base do not agree.

10.2 Data Base Connect Messages -

> ERROR: DECS could not connect to the database.
> WARNING: No fields were verified against the database.

10.3 GCNDB Quadname and Primary State -

ERROR: DLG cell name does not match database.
ERROR: Primary state code is wrong.
ERROR: DLG primary state indicator does not match the database.
ERROR: Cartunit contains erroneous data.
ERROR: Data appears after the state designator.
(Possible missing dash after first state designator.
ERROR: State code is missing after '-' in cartunit.
ERROR: State code should not be followed by a period.

WARNING: Cartunit missing a comma, and may produce database errors.

10.4 GCNDB State Order Checks -

ERROR: DLG second state does not match the database.
ERROR: DLG third state does not match the database.
ERROR: DLG fourth state does not match the database.

10.5 GCNDB State Checks (order unavailable) -

WARNING: State order cannot be determined from database information.
WARNING: DLG second state does not match returned database states.
WARNING: DLG third state does not match returned database states.
WARNING: DLG fourth state does not match returned database states.

10.6 MAPCAT Source Date -

WARNING: DLG source date does not match the database.

10.7 MAPCAT Revision Date -

WARNING: DLG revision date does not match the database.

10.8 MAPCAT Contour Intervals -

WARNING: DLG primary interval does not match the database.
WARNING: DLG secondary interval does not match the database.

10.9 MAPCAT Horizontal/Vertical Datums -

WARNING: Horizontal datum does not match the database.
WARNING: Vertical datum does not match the database.

WARNING: Database returned an invalid horizontal datum.
WARNING: Database returned an invalid vertical datum.

11 Software Management

11.1 DECS+ Problem Reporting -

Please address any software problems to the Office of Primary Responsibility (OPR) listed below. The OPR also maintains an email mailing list of persons interested in receiving information on new releases, updates and problems. You may request your name be included on this list by contacting the OPR.

It is helpful if you include the following information (if available or applicable) in any correspondence:

1.) Clearly describe the problem by supplementing your description with any output messages generated by the software.
2.) Indicate the type of data being used. If the problem was specific to a certain data set, retain a copy of the data set for future testing.
3.) Include your name, phone number, mailing address, email address (if available) and the name of your organization.

Office of Primary Responsibility (OPR):

Rick Brown
Mid-Continent Mapping Center, MS-801
1400 Independence Drive
Rolla, MO 65401

Phone: (573) 308-3525 Fax : (573) 308-3652
Email: reb@usgs.gov

11.2 Data Base Problem Reporting -

If an error is found to be definitely related to the data used in the DECS+ lookups (and not a problem with the software itself), these problems can be reported directly to the appropriate parties listed below.

Realize that the lookup logic in DECS+ could be flawed. So do not report anything directly to these people if it can not be determined that the data itself is in error.

GCNDB:

Linda S. Davis
Phone: (703) 648-4555
Email: lsdavis@usgs.gov

MAPCAT:

John Kretlow
Phone: (703) 648-5938
Email: jmkretlow@usgs.gov